

DISCUSSION OF THE AMENDMENT

Due to the length of the specification herein, Applicants will cite to the paragraph number of the published patent application (PG Pub) of the present application, i.e., US 2007/0202035, when discussing the application description, both in this section and in the Remarks section, *infra*, rather than to page and line of the specification as filed.

Claim 10 has been amended to provide antecedent basis for “fluidized bed” and switching from a plural to a singular format.

Claim 11 has been amended to provide antecedent basis for the term “the gas distributor.” Claim 11 has been additionally, and Claims 12-18, amended by changing claim dependency to a pending claim.

New Claims 19-26 have been added. Claim 19 is supported in the specification at paragraph [0023]. Claims 20-21 are supported in the specification at paragraph [0024]. Claims 22-23 are supported in the specification at paragraph [0025]. Claim 24 is supported in the specification at paragraph [0026]. Claim 25 is supported in the specification at paragraph [0029]. Claim 26 is supported in the specification at paragraph [0046].

No new matter is believed to have been added by the above amendment. Claims 10-26 are now pending in the application. All are active except Claim 18, which is drawn to a non-elected invention.

REMARKS

The rejection of Claims 10-14 under 35 U.S.C. § 103(a) as unpatentable over U.S. 4,137,706 (Clarke), is respectfully traversed.

As recited in Claim 10, an embodiment of the present invention is a process for carrying out an exothermic chemical equilibrium reaction in a fluidized-bed reactor comprising a fluidized bed, wherein there is a temperature distribution along the flow direction in the fluidized bed of the fluidized-bed reactor and **the temperature difference between the lowest temperature and the highest temperature is at least 10 K** and wherein **the temperature within the fluidized bed decreases from an absolute temperature maximum along the flow direction to the surface of the fluidized bed.**

(emphasis added).

Clarke discloses an engine having a first reaction chamber and a second reaction chamber, wherein the second reaction chamber contains reformed fuel discharged from the first reaction chamber, which is passed together with air or other reactant to effect an exothermic chemical reaction therein, and a heat exchanger, such as a fluidized bed type, to transfer the heat produced by the exothermic reaction in the second reaction chamber to the first reaction chamber, in which an endothermic reaction is carried out (Abstract). Clarke exemplifies an embodiment wherein two fluidized bed heat exchangers, respectively, are used, wherein reformed fuel and heated air are passed through fluidized bed 19 of heat exchanger 5 wherein a first exothermic reaction is carried out, and then the products thereof are passed through fluidized bed 18 of heat exchanger 4 where a second exothermic reaction occurs (paragraph bridging columns 2 and 3).

The Examiner concedes that Clarke does not disclose a temperature difference between these two fluidized beds, but holds that it would have been obvious to, in effect, operate within the above-emphasized features of Claim 10 through process optimization.

In reply, while the two exothermic reaction beds of Clarke may be operated at different temperatures, there is neither disclosure nor suggestion of a temperature distribution within any one fluidized bed. In addition, the use of two reaction chambers, each furnished with a fluidized bed, actually teaches away from the use of a reactor comprising one fluidized bed in such a way that there is a temperature difference between the lowest and highest temperature of at least 10 K within the fluidized bed and that the temperature decreases from an absolute temperature maximum along the flow direction to the surface of the fluidized bed.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 10-17 under 35 U.S.C. § 103(a) as unpatentable over U.S. 2002/0172640 (Hibi et al) in view of U.S. 2008/0047872 (Iaccino et al) and U.S. 3,482,946 (Shirk), is respectfully traversed.

Hibi et al discloses a process for producing chlorine by oxidizing hydrogen chloride with oxygen in the presence of a supported ruthenium oxide catalyst (Abstract), which process can be carried out in a reactor such as a fixed bed reactor, fluidized reactor, tank type reactor, and the like [0067]. Hibi et al discloses further that the fluidized bed system has an advantage that the temperature distribution width in the reactor can be reduced because heat in the reactor can be sufficiently removed [0068].

Iaccino et al discloses a process for converting methane to liquid hydrocarbons in at least two reactors in series, such as in multiple catalyst beds with heat removal between beds, and wherein the lead bed(s) may be operated at higher temperatures to maximize kinetic rates and the tail bed(s) may be operated at lower temperatures to maximize thermodynamic conversion [0098].

Presumably based on Iaccino et al, the Examiner holds that it would have been obvious to optimize the temperature difference between the lead bed and the tail bed to

maximize both the kinetic rate and the thermodynamic conversion in the process of Hibi et al.

The Examiner continues that it would have been obvious to carry out this modified process of Hibi et al in a single fluidized bed reactor as suggested by Shirk "because this reactor is compartmented and each component can serve as a 'bed' as suggested in [Iaccino et al] and the temperature in each compartment can be controlled independently to obtain the higher and lower temperatures as desired by [Iaccino et al]."

In reply, without the present disclosure as a guide, one of ordinary skill in the art would not have combined Hibi et al, Iaccino et al, and Shirk. While Shirk discloses a fluidized bed reactor which is separated into several sections by perforated plates, and that the different sections can be heated separately, Shirk discloses that his reactor design provides an excellent means of maintaining the desired operating temperature within about 3 to at most 5 Fahrenheit degrees (column 4, lines 48-51), or well-below the presently-recited minimum of 10 Kelvin degrees (18 Fahrenheit degrees). There is neither disclosure nor suggestion in Shirk that it is possible to set a temperature distribution in the reactor along the flow direction in the fluidized bed, the temperature difference between the lowest and highest being at least 10 K and the temperature within the fluidized bed decreasing from an absolute temperature maximum along the flow direction to the surface of the fluidized bed. Indeed, in order to achieve relatively different temperatures, one skilled in the art would look to Iaccino et al, which requires at least two separate reactors to carry out reaction at different temperatures.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 1-17 under 35 U.S.C. § 103(a) as unpatentable over Hibi et al in view of U.S. 5,573,657 (Degnan et al) and Shirk, is respectfully traversed.

The deficiencies of Hibi et al and Shirk have been discussed above. Degnan et al does not remedy these deficiencies. Degnan et al discloses a hydrogenation process for

reducing the unsaturation of lubricants, which uses a catalyst based on ultra-large pore crystalline material (Abstract) and that for an exothermic process such as hydrogenation, it is thermodynamically favored by lower temperatures but for kinetic reasons, moderately elevated temperatures are normally used and for petroleum refining processes, temperatures in the range of 100° to 700°F are typical (column 1, lines 32-36). The Examiner holds that it would have been obvious to maximize both the kinetic rate and the thermodynamic conversion for the process of Hibi et al by operating the fluidized bed at two different temperatures, i.e., at a higher temperature for kinetic reasons and lower temperature for thermodynamic reasons, as suggested by Degnan et al, and that it would have been obvious to use the apparatus of Shirk.

In reply, there is neither disclosure nor suggestion in Degnan et al that an exothermic chemical reaction can be carried out in a fluidized bed reactor, wherein there is a temperature distribution along the flow direction in the fluidized bed of the fluidized-bed reactor, the temperature difference between the lowest and highest temperatures being at least 10 K and the temperature within the fluidized bed decreasing from an absolute temperature maximum along the flow direction to the surface of the fluidized bed. At best, in order to achieve such different temperatures, one skilled in the art in view of the applied prior art would employ two separate reactors wherein a first reactor is operated at a first temperature and the second reactor at a second temperature, or the part of the reactor is operated at a first temperature and the second part of the reactor is operated at a second temperature. However, a temperature distribution along the fluidized bed wherein the temperature decreases from an absolute temperature maximum along the flow direction to the surface of the fluidized bed cannot be achieved. Nor do any of the applied prior art disclose or suggest a temperature difference between the lowest and highest temperatures of at least 10 K.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

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Reply to Office Action of September 3, 2009

Applicants respectfully submit that all of the presently-active claims in this application are now in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, L.L.P.

Norman J. Oblon



Harris A. Pitlick
Attorney of Record
Registration No. 38,779

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/09)